7

A New Trematode, *Cathaemasia senegalensis,* from the Saddle-bill Stork, *Ephippiorhynchus senegalensis* (Shaw)[1]

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(Text-figure 1)

A PAIR of saddle-bill storks, *Ephippiorhynchus senegalensis,* known in Africa as "Jabiru," were received at the New York Zoological Park, New York City, on July 3, 1964. The female died December 28, 1964, and twenty-six worms were found in the throat and esophagus. Identical worms have been removed from the throat of the male bird also and since in captivity there was no probability of infection by trematodes, it appears that the parasites were acquired in Africa. According to a statement from the Import-Export-Zoo, Animals, Grevenhofsweg 27, Harderwijk, Holland, the birds were imported from Nigeria, and had been in Holland about three weeks before shipment to America. Whether or not they were taken in Nigeria is not definitely established, but the species has a normal range throughout tropical Africa, from Senegal to the Sudan and south to Southern Rhodesia and Natal. It frequents and feeds in swamps by the larger rivers and its food does not differ from that of the white and black storks. According to Bannerman (1953), it is said to be partial to large water-beetles and has been known to swallow a 3-lb. lung-fish. There is no evidence that the saddle-bill is migratory and it appears to be a resident bird. On the upper Nile, it breeds in January and February.

Ten worms were studied as stained and cleared whole-mounts and others in transverse and frontal serial sections. The whole-mounts were stained with paracarmine and the sections with haematoxylin and erythrosin. The worms are ovate in outline, with an anterior, mobile, preacetabular conical portion and a wider, flattened, oval posterior portion (Text-fig. 1). All are sexually mature and their uteri are filled with eggs. Different specimens vary in size from 9 mm. in length and 5 mm. in width to 14 mm. in length and 6.2 mm. in width. The cuticula measures 0.025 to 0.035 mm. in thickness and the ventral preacetabular region bears broad, flat scales, 0.055 to 0.065 mm. in length, each of which is composed of 2-6 fused spines. In certain specimens, the scales, smaller and sparser posteriorly, extend past the acetabular level. The acetabulum, situated about three-eighths of the body length from the anterior end, measures 1.42 to 1.87 mm. in diameter.

The oral sucker is subterminal and varies from 1.00 to 1.87 mm. in diameter. The prepharynx in a sectioned specimen is 0.31 mm. long and 0.22 mm. wide. The anterior end of the worm is often bent ventrad and the pharynx may appear in part dorsal to the oral sucker; in such preparations the prepharynx is not apparent. The pharynx is 0.61 to 0.67 mm. long and 0.53 to 0.57 mm. wide. The esophagus has small lateral evaginations, especially near the anterior end; it extends to a level about midway between the oral and ventral suckers. It is lined with epithelium continuous with that of the digestive ceca, which have small diverticula and end blindly near the posterior end of the body.

The excretory pore is dorsal, near the posterior end of the body, and the system, like that of the echinostomes, is exceedingly branched, forming a reticulum in the parenchyma and a lattice of excretory tubules in the body wall.

The testes are situated, one before the other, in the posterior third of the body. They are dendritic and the branches of the two organs overlap so much that it is difficult and usually impossible to distinguish one from the other. In cross sections, there may be as many as six to eight branches, one above the other. The lobes

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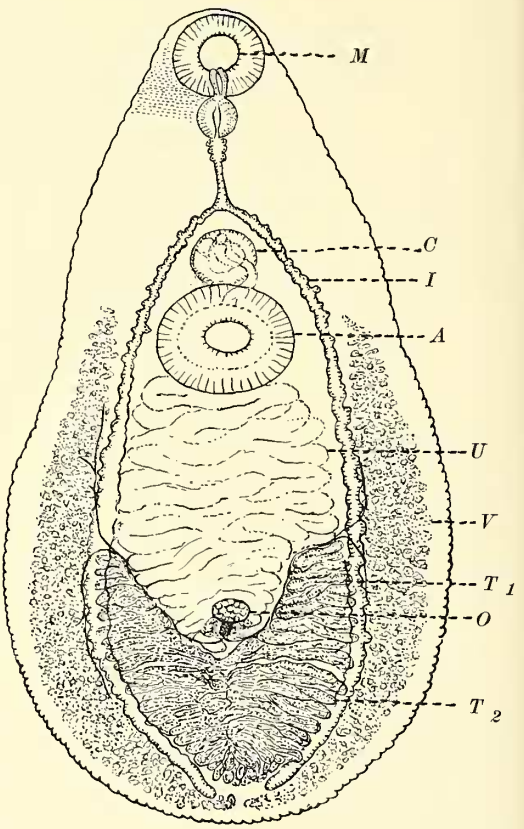
of the testes underlie but do not extend laterally beyond the digestive ceca. The posterior testis is flattened anteriorly where it meets the anterior one and posteriorly it extends almost to the posterior end of the body. The anterior testis has a narrow bridge-like medial portion and two lateral, wing-like portions that extend forward to a level about midway between the acetabulum and the posterior end of the body and far anterior to the ovary. Sperm ducts pass forward on either side between the digestive ceca and the coils of the uterus. They tend mediad and dorsad, and dorsal to the anterior margin of the acetabulum they join to form an S-shaped seminal vesicle, enclosed in the cirrus-sac which is circular to oval, 0.75 to 0.94 mm. in diameter. The vesicle is in the dorsal part of the cirrus-sac; it is followed by a much-coiled ejaculatory duct, the initial portion of which is surrounded by secretory cells. The cirrus-sac is situated immediately anterior to the acetabulum and may in part overlie it; it is dorsal to and slightly right of the metraterm, whose tip is inclosed in the wall of the cirrus-sac.

The ovary is median, situated near the junction of the third and posterior fourths of the body-length. It is spherical to oval, 0.32 to 0.48 mm. in diameter. The oviduct arises at the dorsal posterior margin and turns posteriad and ventrad where it enters Mehlis's gland and expands to form the ootype. As it enters the gland, Laurer's canal is given off and the duct from the vitelline receptacle is received. The vitellaria consist of many small follicles in the extracecal areas from the level of the acetabulum to the posterior end of the body. Usually the follicles are continuous at the posterior end. Vitelline ducts from the anterior and posterior follicles join at the anterior margins of the cephalic testis and the resulting ducts pass posteriad and mediad on the dorsal side of the body. They join behind the ovary to form a large vitelline reservoir from which a common duct passes anteriad and ventrad to open into the oviduct. Spermatozoa may be present in the ootype and the initial portion of the uterus, as it emerges from the ootype, is filled with spermatozoa, but there is no seminal receptacle. The first eggs are suspended in masses of spermatozoa. The uterus coils posteriad until it abuts against the median face of the anterior testis and then forward in transverse loops, sometimes as many as six or eight above one another, between the digestive ceca, to the level of the acetabulum. The terminal portion of the uterus passes on the left and below the cirrus-sac while the metraterm enters the ventral wall of the cirrus-sac to open at the common genital pore. The eggs are thin-shelled, operculate, and when expelled are 0.057 to 0.062 mm. in length, 0.032 to 0.037 mm. in width, and fully embryonated. The miracidia are ocellate and the eye-spots are conspicuous. As noted by Dollfus (1950), the eggs increase in size as they proceed along the uterine coils.



TEXT-FIG. 1. *Cathaemasia senegalensis,* type specimen, 11.5 mm. long, ventral view.

(Abbreviations)

A—Acetabulum
C—Cirrus-sac
I—Intestinal cecum
M—Mouth
O—Ovary
T_1—Anterior testis
T_2—Posterior testis
U—Uterus
V—Vitellaria

Discussion

The genus *Cathaemasia* was erected by Looss (1899) to contain a species described by Rudolphi (1809) as *Distoma hians* from the esophagus of the black stork, *Ardea nigra* (=*Ciconia nigra*) taken at Greifswald, Germany. Mühling (1897) gave a more complete description and figures of the species from parasites found in the esophagus of the white stork, *Ciconia ciconia.* A further account was given by Yoshida & Toyoda (1930) based on specimens from *C. nigra* which had been imported from Africa and autopsied in the Zoological Gardens of Osaka, Japan. The

species, *hians,* was included in the genus *Dicrocoelium* by Dujardin (1845) when he erected that genus, but morphological differences between *Dicrocoelium dentriticum,* type of the genus, and Mühling's redescription of *D. hians* induced Looss (1899) to propose a new genus for the latter species. The genus *Cathaemasia* occupied an isolated taxonomic position until Odhner (1926a) described the excretory system of *C. hians* and predicated its close relationship with the echinostomes, an opinion now generally accepted.

L. Szidat (1939) reported the life-cycle of *C. hians.* Twenty-three worms from the esophagus of *C. nigra* lived for more than a week in water (ca. 23° C.) and shed enormous numbers of eggs. In sunlight, the miracidia emerged promptly and were added to Petri-dishes containing various species of snails. They entered the snails and developed in *Planorbis* spp. and *Lymnaea palustris.* Mother rediae appeared in sporocysts after 10-12 days. Daughter rediae migrated to the digestive gland and 37 days after infection the first cercariae were shed. They proved identical with *Echinocercaria choanophila,* larvae which Ursula Szidat (1936) had found emerging from *Planorbis* spp. and *Lymnaea palustris* and which encysted as metacercariae in the choanae and roof of the mouth in tadpoles of frogs and toads. The green frog, *Rana esculenta,* is eaten regularly by the storks.

Until the discovery of the life-cycle of *C. hians,* the species had uncertain taxonomic relations. Looss (1899) included *Cathaemasia* with *Omphalometra* Looss, 1899, in a new subfamily, Omphalometrinae. Odhner (1911) showed that *Omphalometra* was a member of the Lepodermatidae (= Plagiorchiidae) and that *Cathaemasia* manifested resemblances to the fasciolids. Poche (1926) included *Cathaemasia* in the family Fasciolidae. Fuhrmann (1928) erected the family Cathaemasidae to contain *Cathaemasia* and *Mehlisia* Johnston, 1913, a genus based on *Mehlisia acuminata* Johnston, 1913, an intestinal parasite of the marsupial, *Dasyurus viverrinus,* in Australia. *Mehlisia* was included by Yamaguti (1958) in the family Psilostomidae Odhner, 1913. The discovery of the life cycle of *C. hians* threw new light on the systematic position of *Cathaemasia.* The morphology of the cercariae and the development of circum-oral spines in the metacercarial stage showed intimate relations with the echinostomes. Moreover, Odhner (1926a) had shown that the excretory system of *Cathaemasia* is similar to that of the echinostomes. The adult stage, however, lacks the collar and spines and Szidat noted morphological agreement between *C. hians* and *Philophthalmus nyrocae.* In species of these genera, cuticular spines are largely restricted to the ventral side of the body; the suckers are comparable in location, size and muscular development; they agree in details of the digestive and excretory systems, and in the location of the testes, ovary, uterus and genital pore. In both, the eggs are embryonated when passed and the miracidia are ocellate. Members of these genera live in the esophagus and on the ocular conjunctiva, respectively, of birds, and Szidat predicated that the Cathaemasidae and Philophthalmidae are adventurous echinostomes that have left the intestine and settled in new abodes. The discovery of the life-cycle of *Philophthalmus gralli* by Cable and his students, Fisher & West (1958), however, showed that the philophthalmids have megalurous cercariae and that *Cathaemasia* is nearer the echinostomes and psilostomids than to the Philopthalmidae.

Several species have been assigned to *Cathaemasia;* some of them have been removed to other genera and the taxonomic status of others remains equivocal. Braun (1901) described a second species, *Cathaemasia fodicans,* from a specimen in the Vienna Museum that, according to the label, was from *Sterna nigra,* but later authors, Odhner (1926b), Yoshida & Toyoda (1930) and Szidat (1939), regarded *C. fodicans* as probably identical with *C. hians.* Odhner suggested that the label on the specimen was an error and should have been *Ciconia nigra* rather than *Sterna nigra.* Odhner (1926b) described two new species: *Cathaemasia spectabilis* from the marabou stork, *Leptoptilus crumenifer,* taken 25 years before during the Swedish Expedition to the White Nile, and *Cathaemasia famelica,* based on a single specimen from the nimmersatt, *Tantalus ibis,* taken by the same Expedition. It is a young individual, just beginning egg-production, very similar to *C. spectabilis,* and the differences may be explained by degree of sexual maturity. Mendheim (1940) suppressed *C. spectabilis* as identical with *C. hians,* but the two species are probably distinct.

Wesley (1940) described three new species of *Cathaemasia* from the esophagus of storks taken in the region of Allahabad, U. P., India: *Cathaemasia orientalis* from the white-necked stork, *Dissoura episcopus; Cathaemasia indicus* from the painted stork, *Ibis leucocephalus;* and *Cathaemasia mehrai* from the Indian black ibis, *Pseudibus palillosus.* The last species has a rudimentary or vestigial circum-oral collar, with twelve spines on each ventro-lateral corner. This feature is a prime feature of the echinostomes, and since the internal structure is so similar, Wesley reduced Cathaemasidae to subfamily status, Cathaemasinae, and included it in the

family Echinostomidae. The cercariae and metacercariae of *C. hians* have circum-oral collars and spines and otherwise are very similar to those of *Echinostoma revolutum;* moreover, the adults of *C. mehrai* have collars and spines and are so similar in internal morphology that the decision by Wesley appears reasonable and justified. An additional species was described by Wesley (1943) : *Cathaemasia seetali* from *Xenorhynchus asiaticus.*

Von Linstow (1906) described specimens from the esophagus of the white-necked stork, *Dissoura episcopus,* taken in Ceylon, as *Lyperosomum squamatum.* On bionomic and morphological grounds, Odhner (1926b) suspected that the species belongs in *Cathaemasia,* and Dollfus (1950) made the definite assignment, *Cathaemasia squamata.* Travassos (1951) disagreed, but despite the superficial and in part erroneous original description, Dollfus was probably correct. Von Linstow represented the ovary as posttesticular but the figure is a schematic representation and the description, except for the location of the ovary, agrees so completely with the description of *Cathaemasia orientalis* by Wesley (1940) from the same host, that the two may be identical. In this species the ovary is very small and may be covered by coils of the uterus. It is probable that von Linstow overlooked the ovary and described the posterior lobe of the caudal testis as the ovary. Dollfus (1950) made the combination *Cathaemasia squamata,* and if the two are identical the correct name of the species is *Cathaemasia squamata* (von Linstow, 1906) Dollfus, 1950, and *C. orientalis* disappears as a synonym.

In his paper, Dollfus (1950) described and figured a single specimen from the throat of *Ardea goliath* as *C. hians.* Travassos (1951) studied specimens in the Helminthological Collection of the Instituto Oswaldo Cruz, taken from throats of Indian storks, *Xenorhynchus asiaticus,* which he considered identical with the specimen described by Dollfus and which he described as a new species, *Cathaemasia dollfusi.* Neither Dollfus nor Travassos referred to the account by Wesley (1940). However, since *C. dollfusi* occurs in *Xenorhynchus asiaticus* and the description and figures of *C. dollfusi* are so similar to those of *Cathaemasia seetali* Wesley, 1943, there is a strong presumption that the two are identical. If this suspicion is correct, *C. dollfusi* is a synonym of *C. seetali.* Pande, Ahlewalia & Srivastava (1960) reported five immature specimens from the throat of *X. asiaticus* and *Ibis cancocephalus,* but specific determination was limited to *Cathaemasia* sp.

Elizabeth van den Broek (1960) described a new species, *Cathaemasia variabilis,* from the esophagus of abdim storks, *Sphenorhynchus abdimii,* collected in Africa and examined in the Zoological Gardens of Amsterdam. Macko (1960) recognized two subspecies of *C. hians: C. hians hians* and *C. hians longivitellata.* A new species, *Cathaemasia skrjabini,* was described by Feizullaev (1961) from *Ciconia ciconia* taken in Azerbaijan, South Russia. In this species the vitellaria extend forward to the level of the genital bursa. If this species is identical with *C. hians longivitellata,* as seems probable, the specific name becomes *longivitellata* and *skrjabini* is a synonym. In a second report, Feizullaev (1962) reported morphological differences in *C. hians* as a result of development in different intermediate hosts.

Leidy (1891) described a species from the American osprey, *Pandion carolinensis,* as *Distoma trapezium,* a species which Stiles & Hassall (1894) declared is identical with *Distoma reticulatum* Wright, 1879.

Travassos (1916) described *Pulchrosoma pulchrosoma* from the abdominal air-sacs of *Megaceryle torquata* taken in Brazil and included it in the subfamily Omphalometrinae. Harwood (1936) redescribed *Distoma reticulatum* Wright, 1879, from the air-sacs of the belted kingfisher, *Megaceryle alcyon,* and assigned the species to *Cathaemasia.* Zeliff (1941) described three specimens from *M. alcyon* as *Cathaemasia reticulata* (Wright, 1879) Harwood, 1936. Caballero & Flores (1948) described ten specimens from *M. torquata* taken in Mexico, similar to and presumably identical with those of Wright, as *Cathaemasia reticulata.* They predicated that *P. pulchrosoma* is identical with *C. reticulata* and suppressed *Pulchrosoma* as a synonym. Manter (1949) reported a single specimen from the body cavity of *M. alcyon* taken in Nebraska, and agreed that *Pulchrosoma* is a synonym of *Cathaemasia.* Olsen (1940) described two specimens from the intestine of the black crowned night-heron, *Nycticorax nycticorax,* as a new species, *Cathaemasia nycticoracis,* but the worms do not agree with the generic concept of *Cathaemasia* and their systematic position is uncertain.

Travassos (1951) insisted on the validity of the genus *Pulchrosoma* and recognized two species: *P. pulchrosoma* from *M. torquata,* and the species from *M. alcyon* which he had designated earlier as *Pulchrosoma reticulata* (Wright, 1879) Travassos, 1939. The contention of Travassos is strongly supported since the species of *Pulchrosoma* and *Cathaemasia* differ in morphology, in site of infection, and in the orders of birds that serve as final hosts. Travassos divid-

ed the family Cathaemasiidae into two subfamilies: Cathaemasiinae which was ascribed to Dollfus (there was no reference to Cathaemasiinae of Wesley), and Ribeiroiinae, a new subfamily. Cathaemasiinae contained three genera: *Cathaemasia, Pulchrosoma* and *Cathaemasioides;* Ribeiroiinae contained two genera: *Ribeiroia* Travassos, 1919, and *Trifolium* Travassos, 1922.

The genus *Cathaemasioides* was erected by Teixeira de Freitas (1941) to contain a new species, *Cathaemasioides callis,* from the South American stork, *Euxenura galeata.* The location in the host was not given. *Cathaemasioides* was distinguished from *Cathaemasia* on two features: the posterior portions of the digestive ceca bear short lateral branches and the vitellaria do not extend posteriorly beyond the testicular level. These characteristics are hardly adequate to delineate a new generic concept and the species should be included in *Cathaemasia* as *Cathaemasia callis* (Teixeira de Freitas, 1941) n. comb.

Szidat (1940) discussed the parasites of storks and the evidence supplied by the helminthic and arthropodal species on the questions of ecology, phylogeny and ancestral home of these birds. Evidence supports the idea that the original home was central Africa, from which they have dispersed. The species that live in tropical areas are resident, whereas the white and black storks are migrants that breed in northern regions and winter in Africa. Szidat had demonstrated that these birds become infected with *C. hians* when juveniles in their northern range. Concerning *C. hians* he observed, p. 565, "Dieser Trematode scheint nur in unseren beiden Storcharten vorzukommen. Auch die Gattung ist in ihrem Vorkommen nach allen, was wir wissen, durchaus auf Ciconiidae beschränkt." The species of *Cathaemasia* which infect storks resident in Africa and Asia obviously would use intermediate hosts other than those of the migrant storks whose asexual generations occur in European snails. It follows that the parasites employ different intermediate hosts in Africa and Europe, which may accelerate speciation. There are seventeen species of living storks which range from South America to Australasia and members of at least ten genera are known to harbor some ten or twelve species of *Cathaemasia.* It appears that the hosts have evolved more rapidly than their trematode parasites. However, the parallel distribution of hosts and parasites can hardly be accidental. The presence of *Cathaemasia callis* in the South American storks, *Euxenura galeata,* is remarkable, in view of the temporal and geographic separation of New World species. A further divergence is manifest by the two species of the genus *Pulchrosoma,* from the air-sacs of American kingfishers. They are members of the Cathaemasiinae, but infect birds of the order Coraciiformes, distinct from the Ciconiiformes.

The specimens from *Ephipphiorhynchus senegalensis* are described as a new species, *Cathaemasia senegalensis.* Type and paratype specimens are deposited in the Helminthological Collection of the U. S. National Museum under the numbers, 60687 and 60688. The specimens agree better with *C. dollfusi* than any other species, but differ from all in the form and location of the gonads. In all other species the ovary is pretesticular, whereas in *C. senegalensis* the ovary is situated between lateral lobes of the anterior testis. In *C. senegalensis,* the testes are more branched, more massive, and the branches interdigitate to such an extent that in most specimens the testes appear to merge.

Literature Cited

Bannerman, D. A.

1953. The Birds of West and Equatorial Africa. Oliver and Boyd, London.

Braun, M.

1901. Zur Revision der Trematoden der Vögel. Centr. Bakt., Abt. 1, 29: 895-897.

Broek, Elizabeth van den

1960. *Cathaemasia variabilis* n. sp. (Trematoda: Cathaemasiidae) from the esophagus of *Sphenorhynchus abdimii.* Jour. Helminth., 34: 243-246.

Caballero, E., & L. Flores

1948. Parasitismo de *Streptoceryle torquata torquata* por *Cathaemasia reticulata* (Wright, 1879) Harwood, 1936 (Trematoda: Echinostomatidae). Anal. Escula Nacion. Cien. Biol., 5: 223-227.

Dollfus, R. P.

1950. Trématodes récoltés au Congo belge par le Professeur Paul Brien (mai-août, 1937). Ann. Mus. Belg. Congo, C—Zoologie, ser. V, 1: 1-136.

Dujardin, F.

1845. Histoire naturelle des helminthes ou vers intestinaux. Paris.

Feizullaev, N. A.

1961. A new trematode, *Cathaemasia skrjabini* n. sp., from *Ciconia ciconia* in Azerbaijan. Dokladi Akad. Nauk Azerbaijan SSSR., 17: 63-65.

1962. The divergence in two species of trematodes, *Cathaemasia hians* (Rudolphi, 1809) and *Chaunocephalus ferox* (Rudolphi, 1795) Dietz, 1909, on change of the intermediate hosts. Dokladi Akad. Nauk SSSR., 146: 238-241.

Fisher, F. M., Jr., & A. F. West
1958. *Cercaria megalura* Cort, 1914, the larva of a species of *Philophthalmus*. Jour. Parasitol., 44: 648.

Fuhrmann, O.
1928. Trematoda, *in* Handbuch der Zoologie, Kükenthal u. Krumbach, 2: 1-140.

Harwood, P. D.
1936. Notes on Tennessee helminths, III. Two trematodes from a kingfisher. Jour. Tenn. Acad. Sci., 11: 251-256.

Leidy, J.
1891. Notices on Entozoa. Proc. Acad. Nat. Sci., Philadelphia, 42: 410-418.

Linstow, O. von
1906. Helminthes from the collection of the Colombo Museum. Spolia Zelanica, 3: 163-188.

Looss, A.
1899. Weitere Beiträge zur Kenntnis der Trematodenfauna Aegyptens, zugleich Versuch einer natürlichen Gliederung des Genus *Distomum* Retzius. Zool. Jahrb., Syst., 12: 521-784.

Macko, J. K.
1960. Differenzierung von *Cathaemasia hians* (Rudolphi, 1809) auf zwei Unterarten, *C. hians hians* (Rud. 1809) and *C. hians longivitellata* subsp. nov. Helminthol. Bratislava, 2: 270-275.

Manter, H. W.
1949. The trematode *Cathaemasia pulchrosoma* (Travassos, 1916) n. comb. from the body cavity of a kingfisher *(Megaceryle alcyon)* in Nebraska. Jour. Parasitol., 35: 221.

Mendheim, H.
1940. Beiträge zur Systematik und Biologie der Familie Echinostomatidae (Trematoda). Nova Acta Leopoldina, n.f. 8 (54): 497-588.

Mühling, P.
1897. Beiträge zur Kenntniss der Trematoden. Arch. Naturg., Jahrg. 62: 243-279.

Odhner, T.
1911. Zum natürlichen System der digenen Trematoden. IV. Zool. Anz., 38: 513-531.
1926a. *Protofasciola* n. g., ein Prototypus des grossen Leberegels. Arkiv. Zool., 18A (20): 1-7.
1926b. Zwei neue Arten der Trematodengattung *Cathaemasia* Looss. Arkiv. Zool., 18B (10): 1-4.

Olsen, O. W.
1940. Two new species of trematodes (*Apharyngostrigea bilobata*: Strigeidae, and *Cathaemasia nycticoracis*: Echinostomidae) from herons, with a note on the occurrence of *Clinostomum campanulatum* (Rud.). Zoologica, New York, 25: 323-328.

Pande, B. P., S. S. Ahlewalia, & J. S. Srivastava
1960. Note on host-parasite relationships observed in fluke infections of wild aquatic birds. Parasitol., 50: 323-327.

Poche, F.
1926. Das System der Platodaria. Arch. Naturg., A. 91: 1-240.

Rudolphi, C. A.
1809. Entozoorum sive vermium intestinalium historia naturalis. Vol. 2. Amstelaedami.

Stiles, C. W., & A. Hassall
1894. A new species of fluke *(Distoma* [*Dicrocoelium*] *complexum)* found in cats in the United States, with bibliographies and diagnoses of allied forms. (Notes on parasites. 21) Veterinary Mag., 1: 413-432.

Szidat, L.
1939. Beiträge zum Aufbau eines natürlichen Systems der Trematoden. I. Die Entwicklung von *Echinocercaria choanophila* U. Szidat zu *Cathaemasia hians* und die Ableitung der Fasciolidae von den Echinostomidae. Zeit. Parasitenk., 11: 239-283.
1940. Die Parasitenfauna des weissen Storches und ihre Beziehungen zu Fragen der Ökologie, Phylogenie und der Urheimat der Störche. Zeit. Parasitenk., 11: 563-592.

Szidat, Ursula
1936. Ueber eine neue Echinostomidencercarie, *Echinocercaria choanophila* n. sp. Zool. Anz., 116: 304-310.

Teixeira de Freitas, J. F.
1941. *Cathaemasioides callis* n. g., n. sp., trematodeo parasito de *Euxenura* galeata (Molina). Mem. Oswaldo Cruz, 35: 489-492.

Travassos, L.
1916. Informações sobre a fauna helmintologica sul fluminense II. Brasil. Med., 30: 312-314.
1951. O gênero *Pulchrosoma* Travassos, 1916 e sua situação no sistema de trematódeos. Arq. Zool. Estado S. Paulo, 7: 465-492.

Wesley, W. K.
1940. Studies on the Indian species of the genus *Cathaemasia* Looss with discussion on the family Cathaemasidae Fuhrmann, 1929. Proc. Nat'l Acad. Sci., India, 10B: 31-40.
1943. On a new species of the genus *Cathaemasia* Looss. Proc. Nat'l Acad. Sci., India, 13: 328-332.

YAMAGUTI, S.
1958. Systema Helminthum. Interscience, New York.

YOSHIDA, S., & K. TOYODA
1930. Notes on *Cathaemasia hians* (Rudolphi) from the mouth of *Ciconia nigra*. Ann. Trop. Med. Parasitol., 24: 85-94.

ZELIFF, C. C.
1941. Observations on *Cathaemasia reticulata*, a trematode from the belted kingfisher. Amer. Natur., 75: 508-512.